

## PATENT ABSTRACTS OF JAPAN

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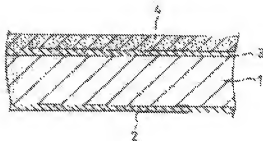
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## (54) COATED STEEL SHEET FOR EXTERIOR

## (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a coated steel sheet for exterior which can cover up insufficient characteristics of a fluoroplastic coated steel sheet, such as faults of being impaired or pressure-marked easily or tending to cause ice or the like to slip down, in particular, while it is capable of ensuring such characteristics as resistances to weather, corrosion, chemicals and heat that the fluoroplastic coated steel sheet has.

**SOLUTION:** An Al-Zn alloy plated steel sheet of 5-65 wt.% being used as a base, a resin coating blended with a rustproof pigment is baked to coat the surface side of the base so that the thickness of a dry coat is 1-5  $\mu\text{m}$ , and thereby a prime coat layer is formed. A topcoat layer is formed on the prime coat layer. As for the resin coating for the topcoat layer, an acrylic resin coating of 18-120 pts.wt. is blended in a fluoroplastic coating of 100 pts.wt. and further ceramic fibers of 0.5-30 pts.wt. to 100 pts.wt. of the blended resin coating is blended with this resin coating. The resin coating of the topcoat layer is baked for coating so that the thickness of the dry coat is 7-19  $\mu\text{m}$ .



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## CLAIMS

[Claim(s)]

[Claim 1] A 5 to 65-% of the weight aluminum-Zn alloy-plating steel plate by which the surface treatment was carried out is used as a substrate, Carry out baking finish of the plastic paint which blended a rust preventive pigment with the surface side of this substrate so that dry film thickness may be set to 1-5 micrometers, and an under coat is formed, Finishing coat is formed on this under coat, and plastic paint of that finishing coat, To fluoro-resin system paint 100 Weight section, are carrying out 18-120 weight-section combination, and further an acrylic resin system paint in these compounded resin paints. A coated steel sheet for the exterior which is carrying out 0.5-30 weight-section combination of the ceramic fiber to plastic paint 100 weight section, and is characterized by carrying out baking finish of the plastic paint of said finishing coat so that dry film thickness may be set to 7-19 micrometers.

[Claim 2] The coated steel sheet for the exterior according to claim 1 in which said substrate is a 45 to 65-% of the weight aluminum-Zn alloy-plating steel plate.

[Claim 3] The coated steel sheet for the exterior according to claim 1 or 2 with which an acrylic resin system paint of said finishing coat has blended thermosetting acrylics and a thermoplastic acrylic resin at ten to 90:90 to 10 % of the weight.

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## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the coated steel sheet for the exterior used for building materials, such as a roof and a wall.

[0002]

[Description of the Prior Art]As this kind of a coated steel sheet for the exterior, there is a fluoro-resin coated steel sheet (a paint is the not less than 80% fluoro-resin main ingredients), and compared with the steel plate which painted other plastic paint, this fluoro-resin coated steel sheet has weatherability, corrosion resistance, chemical resistance, and heat resistance, and fits the building material.

[0003]

[Problem(s) to be Solved by the Invention]However, a fluorocarbon resin coating is expensive, and since dry film thickness is moreover set as film thickness usually thick in 25-30 micrometers and a coated steel sheet, it causes a high cost of the fluoro-resin coated steel sheet. Since a fluoro-resin coat is a flexible coat, it tends to produce a crack at the time of processing. Since the surface is smooth, it is easy to slide down snow and ice, and a crack may arise in the fluoro-resin paint film surface after [ this ] sliding down. If the crack arose, moisture (acid rain, acid snow, acid fog) permeated easily on the surface of the metal plate, for example, when a metal plate is a galvanized steel sheet, the zinc ion of the plating side began to melt through the coat, the phenomenon in which a coat was broken by it arose, and it has left the problem to corrosion resistance. Since the fluoro-resin paint film surface was not so hard, the pressure mark etc. were attached easily.

[0004]The purpose of this invention is to provide the coated steel sheet for the exterior which secures weatherability, corrosion resistance, chemical resistance, and heat resistance, and can aim at antislip nature, such as a sex with a crack-proof, abrasion resistance, and ice, and

further corrosion-resistant improvement with profit by adding an improvement to a fluoro-resin coated steel sheet.

[0005]

[Means for Solving the Problem]A coated steel sheet for the exterior of this invention uses as a substrate a 5 to 65-% of the weight aluminum-Zn alloy-plating steel plate by which the surface treatment was carried out, Carry out baking finish of the plastic paint which blended a rust preventive pigment with the surface side of this substrate so that dry film thickness may be set to 1-5 micrometers, and an under coat is formed, On this under coat, form finishing coat, and plastic paint of that finishing coat, To fluoro-resin system paint 100 weight section, are carrying out 18-120 weight-section combination, and further an acrylic resin system paint in these compounded resin paints, 0.5-30 weight-section combination of the ceramic fiber is carried out to plastic paint 100 weight section, and it has the feature to carry out baking finish of the plastic paint of said finishing coat so that dry film thickness may be set to 7-19 micrometers.

[0006]In this case, it is more preferred to use an aluminum-Zn alloy-plating steel plate for the above-mentioned substrate 45 to 65% of the weight. It is more preferred to use what blended thermosetting acrylics and a thermoplastic acrylic resin at ten to 90:90 to 10 % of the weight for an acrylic resin system paint of the above-mentioned finishing coat.

[0007]

[Function]Since it is using the aluminum-Zn alloy-plating steel plate as the substrate five to 65% of the weight, the coated steel sheet for the exterior of the above-mentioned composition is excellent in heat resistance compared with a galvanized steel sheet, and since there is little elution of the zinc ion from the plating layer which lets a coat pass, it is excellent also in corrosion resistance. In less than 5% of the weight of an aluminum-Zn alloy-plating steel plate, heat resistance and corrosion resistance cannot fully be expected. The corrosion resistance of the shearing end face falls in the aluminum-Zn alloy-plating steel plate exceeding 65 % of the weight.

[0008]By having blended ceramic fiber and an acrylic resin with finishing coat, a crack, a pressure mark, etc. at the time of processing become difficult to be attached, and abrasion resistance can be given. Since finishing coat is using the fluoro-resin as the main ingredients, chemical resistance is also securable.

[0009]By making the finish coating film surface coarse by combination of ceramic fiber, it becomes difficult to slide down ice etc. and can prevent with this crack depended for sliding down.

[0010]The dry film thickness of finishing coat can aim at reduction of paint cost by making thin dry film thickness of 7-19 micrometers and an under coat with 1-5 micrometers.

[0011]When thermosetting acrylics is blended with the acrylic resin system paint of finishing coat, degradation of a fluoro-resin with the passage of time can be controlled. The cost can be

cut down if it is made the low fluorocarbon resin coating which lowered the loadings of the fluoro-resin to an acrylic resin in finishing coat.

[0012]

[Embodiment of the Invention]The suitable embodiment of the coated steel sheet for the exterior of this invention is described.

[0013]The coated steel sheet for the exterior concerning this invention forms an under coat in the surface side of a substrate, and forms finishing coat on this under coat. An aluminum-Zn alloy-plating steel plate is used for the above-mentioned substrate five to 65% of the weight. In less than 5% of the weight of an aluminum-Zn alloy-plating steel plate, heat resistance and corrosion resistance cannot fully be expected, but the corrosion resistance of the shearing end face falls in the aluminum-Zn alloy-plating steel plate exceeding 65 % of the weight. For this reason, an aluminum-Zn alloy-plating steel plate is used 45 to 65% of the weight more preferably.

[0014]By making 0.5 or more weight sections of Si contain to Al content in an alloy plating layer in an aluminum-Zn alloy-plating steel plate five to 65% of the weight, In forming a plating layer in a steel plate, it can control that the weak iron content alloy layer in an interface with a steel sheet surface alloy plating is formed, and the adhesion of a steel plate and a plating layer can be raised. The loadings of Si make ten weight sections a maximum, and if it is exceeded, they will cause the fall of the processability of a plating layer. If 1.0-5.0 weight-section combination of Mg is carried out at an alloy plating layer, it can control more effectively that zinc is eluted from an alloy plating layer under a corrosive atmosphere. If more [ when there are few loadings of Mg than 1.0 weight sections, said effect is thin, and ] than 5.0 weight sections, hardness will become high and processability will worsen.

[0015]Although an under coat is formed in the surface side of a substrate, before painting this under coat, surface treatments, such as chromate treatment, are beforehand performed to a substrate. The paint which uses epoxy system resin, polyester system resin, acrylic resin, urethane system resin, etc. as the main ingredients is used for the plastic paint of an under coat. It blends a rust preventive pigment with the above-mentioned resin, and secures corrosion resistance while baking finish of the under coat is carried out thinly and if plans low cost so that dry film thickness may be set to 1-5 micrometers. If dry film thickness is thinner than 1 micrometer, corrosion resistance and adhesion will become low, and if thicker than 5 micrometers, it will become a paint high cost. Although rust preventive pigments may be zinc chromate, strontium chromate, etc., If an environmental problem is taken into consideration, a metallic flake pigment like an aluminium powder, ionic exchange nature paints like Ca-silica, soluble colors like an phosphate or molybdate, etc. are good in the zinc dust end of non chromium. The loadings of a rust preventive pigment are five to 50 weight section to the resin 100 above-mentioned weight section. The baking plate temperature of the under coat 2 is 180-

240 degrees.

[0016]The plastic paint of the finishing coat by which baking finish is carried out on an under coat, is a paint which uses as the main ingredients what blended the acrylic resin to the fluoro-resin. An acrylic resin is compensated with the ease of getting damaged of the fluoro-resin at the time of processing. Fluoro-resins are polyvinylidene fluoride resin, polyvinyl fluoride, etc. Since the characteristic which a fluoro-resin has will diminish if more [ to fluoro-resin 100 weight section, when there are few loadings of an acrylic resin than 18 weight sections the above-mentioned processability effect is inferior, and ] than 120 weight sections, What carried out 48-120 weight-section combination of the acrylic resin to fluoro-resin 100 weight section is preferred, and is 25 to 50 weight section more preferably.

[0017]If it is made what was blended with thermosetting acrylics with the work which controls especially degradation of a fluoro-resin with the passage of time 100% although it may be a thermoplastic acrylic resin, it becomes the deterioration prevention at the time of processing, and acrylic resin coating is advantageous, even if the storage time as a coated steel sheet serves as a long period of time. Thermosetting acrylics serves as molecular structure hardened in three dimensions after baking finish, this molecular structure passes through it and it cannot receive influence in the time easily, will control the crystal growth of a fluoro-resin, will maintain a small crystal, and deters degradation of a fluoro-resin with the passage of time. Since thermosetting acrylics raises the hardness of a finish coating film, it serves to reduce generating of the crack at the time of press working of sheet metal, and a pressure mark. The mixing ratio of thermosetting acrylics and a thermoplastic acrylic resin is made into ten to 90:90 to 10 % of the weight. Out of the range of this mixing ratio, the above-mentioned processability and the function of both deterioration prevention of a fluoro-resin with the passage of time are not fully obtained. The more desirable mixing ratio is 40 to 60:60 to 40 % of the weight.

[0018]0.5-30 weight-section combination of the ceramic fiber is carried out to resin-solid-content 100 weight section at the compounded resin paint of a fluoro-resin system paint and an acrylic resin system paint. Ceramic fiber uses alumina, silica, zirconia, etc. as the main ingredients. The length of 2-5 micrometers and ceramic fiber of the diameter of ceramic fiber is 5-150 micrometers. Such ceramic fiber raises the sex with a crack-proof of a finish coating film, and pressure-proof mark nature, and since it makes the finish coating film surface coarse, it becomes difficult to be frozen. Ice etc. are made hard to set to  $R_a=0.5-2.5$ micrometer and  $R_{max}=10-30$ micrometer the relative roughness on the surface of a finish coating film which blended ceramic fiber, and to slide on. If there are few loadings of ceramic fiber than 0.5 weight sections, it will become fully difficult to acquire the above-mentioned effect, and if more than 30 weight sections, the elongation of a finish coating film will fall extremely and bending work nature will worsen. The loadings of more desirable ceramic fiber are 0.5 to 3 weight

section.

[0019]The dry film thickness of finishing coat shall be 7-19 micrometers. In less than 7 micrometers, depending on paint color, concealment nature is inferior, and if 19 micrometers is exceeded, it will become a paint cost hike. The dry film thickness of more desirable finishing coat is 13-17 micrometers. Adopting roll coating as paint of top coat, baking plate temperature is 220-280 degrees.

[0020]Adiathermancy can also be given to top coat if scale-like aluminium powder, mica powder, etc. are blended. A these scale-like substance carries out 2-60 weight-section combination to paint 100 weight section. If there are few loadings of a scale-like substance than the amount part of duplex, adiabatic efficiency is not expectable, and if more than 60 weight sections, the adhesion of a finish coating film will fall. As for especially the size of a scale-like substance, it is preferred that it is 20 micrometers or less 50 micrometers or less. A scale-like substance is well located in a line with a finish coating film side and parallel as it is 20 micrometers or less, corrosion resistance improves by this and adiabatic efficiency also improves. If 50 micrometers is exceeded, when a scale-like substance is not level located in a line with a finish coating film side, adiabatic efficiency and a corrosion-resistant effect will decrease.

[0021]Baking finish of the paint which uses a polyester resin system, an epoxy resin system, an acrylic resin system, a urethane resin system, etc. as the main ingredients is carried out to the rear-face side of a substrate. Strontium chromate etc. may be blended with this rear-face paint as a rust preventive pigment. The dry film thickness of this rear-face paint is 1-10 micrometers. This rear-face paint is good as for two quart.

[0022]

[Example]The section structure of the coated steel sheet concerning the example of this invention is typically shown in example 1 drawing 1. The 55-% of the weight aluminum-Zn alloy hot-dipping steel plate (henceforth the steel plate 1) of the 0.4-mm thickness by which chromate treatment was carried out as the substrate 1 is used. The predetermined back coating layer 2 is formed in the rear face of the steel plate 1.

[0023]The under coat 3 is formed in the surface of the steel plate 1. The polyester system plastic paint which blends 30 weight sections of rust preventive pigment zinc chromates to paint 100 weight section was painted with a roll, and it printed and dried by 200 degrees of board temperature C, and the under coat 3 was formed so that it might become the dry film thickness of 4 micrometers.

[0024]The finishing coat 4 is formed on the under coat 3. 80 weight sections of acrylic resins were blended with the plastic paint of the finishing coat 4 to fluoro-resin 100 weight section, and this acrylic resin is blended at a rate of thermoplastic acrylic resin:thermosetting acrylics =3:2. 1.9 weight sections of ceramic fiber is blended with the plastic paint of this finishing coat

4 into a coat. Besides, the plastic paint of the coat 4 is painted by a roll coater, and is printed and dried by 250 degreeC, and it is formed so that dry film thickness may be set to 15 micrometers.

[0025]Next, drawing 2 is made reference and an example of the manufacturing method of the coated steel sheet of the above-mentioned composition is explained. The end of the long steel plate 1 wound around rolled form is pulled out, it leads to the pretreatment part 11, and predetermined surface treatments, such as degreasing, washing, and chromate treatment, are performed to the steel plate 1 in this pretreatment part 11. Subsequently, the steel plate 1 after this pretreatment is led to the under coat painted part 12 and the rear-face painted part 13 one by one. After applying the polyester system plastic paint for under coat formation mentioned above on the surface of the steel plate 1 and performing back paint at the rear face of the steel plate 1, the under coat 3 with a dry film thickness [ like drawing 1 ] of 4 micrometers and the predetermined back coating layer 2 are formed by printing and drying by 200 degrees of board temperature C in the 1st baking furnace 14. By leading this steel plate 1 to the finish coating part 15, applying the paint for finishing coat formation mentioned above on said under coat 3, and printing and drying by 250 degrees of board temperature C in the 2nd baking furnace 16, The finishing coat 4 with a dry film thickness [ like drawing 1 ] of 15 micrometers is formed, and, finally it rolls round to rolled form.

[0026]Comparative example 1 under coat is a polyester system resin paint film which is the dry film thickness of 7 micrometers, and it is the same as Example 1 except finishing coat being a fluoro-resin system coat (80 % of the weight of fluoro-resins) which is the dry film thickness of 25 micrometers.

[0027]It is the same as Example 1 except comparative example 2 under coat being a polyester system resin paint film which is the dry film thickness of 8 micrometers, and finishing coat being a polyester system resin paint film which is the dry film thickness of 15 micrometers.

[0028]The slide sex test of the ice about the coated steel sheet of Example 1 and the comparative examples 1 and 2, a taper wear test, a pressure mark examination, the medicine sex test, and the CAS (corrosion resistance) examination were carried out in the following way.

[0029](1) Water was sprayed on the icy slide sex-test specimen, ice was placed, and it was made to freeze for 2 hours. 20 degrees of specimens were made to incline in a place with a room temperature [ C ] of 20 degrees, this was placed, and time for ice to slide down was measured.

(2) It examined by the taper wear test [JIS K5400 8.9 (abrasion resistance)]. A tapered shape wear ring adds the load 9.81N (1.0Kgf) using CS10.

(3) It carried out by uniting rear surface coats on condition of 24 hours x pressure-proof mark examination 20 kg/cm<sup>2</sup>x40-degreeC.



(4) It was immersed in the solution of 5% of the chemical corrosion resistance test NaOH, and the solution of 5%  $H_2SO_4$  for 240 hours, respectively, and the degree of discoloration of a coat was seen.

(5) It judged in the RN (R. N) standard drawing table by viewing of the attached chart 1 of CAS (corrosion resistance) examination [JIS H8681 5.(CASS test method)] JIS H8681.

[0030] The result of test-result each examination is as being shown in the chart of drawing 3. Finishing coat in the combination paints of a fluoro-resin system paint and an acrylic resin system paint (mixture of a thermoplastic acrylic resin and thermosetting acrylics) and Example 1 which carried out specified quantity addition of the ceramic fiber. Probably, it turns out that finishing coat is excellent in a fluoro-resin system coat or a polyester resin system coat especially at icy skid nature, abrasion resistance, and pressure-proof mark nature as compared with the comparative examples 1 and 2 which do not add ceramic fiber.

[0031] It is the same as Example 1 except having used the aluminum-Zn alloy-plating steel plate for the substrate 6% of the weight, and having used the acrylic resin of finishing coat as the thermoplastic acrylic resin 100% in two to example 4 Example 2. It is the same as Example 1 except having used the aluminum-Zn alloy-plating steel plate for the substrate 6% of the weight in Example 3, and having made the mixing ratio of a thermoplastic acrylic resin and thermosetting acrylics into 60:40 % of the weight as an acrylic resin of finishing coat. It is the same as Example 1 except having used the aluminum-Zn alloy-plating steel plate for the substrate 6% of the weight in Example 4, and having made the mixing ratio of a thermoplastic acrylic resin and thermosetting acrylics into 40:60 % of the weight as an acrylic resin of finishing coat.

[0032] As a deterioration test of the coated steel sheet of Examples 2-4 with the passage of time, the no crack T number (bending work nature) of early (immediately after paint) and the no crack T number after doing a promotion weatherability examination for six days in the atmosphere of 60 degreeC were counted. This test result is as being shown in drawing 4. It turns out that Examples 3 and 4 which blended a thermoplastic acrylic resin and thermosetting acrylics excel Example 2 which uses a thermoplastic acrylic resin 100% as an acrylic resin of finishing coat in the deterrent effect of degradation of finishing coat with the passage of time.

[0033]

[Effect of the Invention] securing the characteristics, such as the weatherability of a fluoro-resin coated steel sheet, corrosion resistance, chemical resistance, and heat resistance, according to this invention -- \*\*\*\* -- while. The characteristic which the steel plate runs short of especially a crack, a pressure mark, etc. are attached easily, and there is an advantage that the coated steel sheet for the exterior with which a fault, such as being easy to slide down ice etc., is suppliable can be provided by low cost.

[Translation done.]